INTER-LABORATORY PROFICIENCY TESTING OF NDT LABS ACCORDING TO ISO 17043 AS A TOOL FOR CONTINUOUS IMPROVEMENT PRINCIPLE ACCORDING TO ISO 9001

Tomáš ZAVADIL

ATG (Advanced Technology Group), Ltd., Prague 9, 199 02, Czech Republic
E-mail: zavadilt@atg.cz

Abstract
Inter-laboratory proficiency testing of NDT laboratories acc. to ISO 17043 is an effective tool to select laboratories competent to perform the NDT tasks according to the customer requirements in desired quality especially. The goal of this article is to show that inter-laboratory proficiency testing is also a relevant tool for assessing the continuous improvement principle acc. to ISO 9001. It is demonstrated how proficiency testing may help the NDT labs to fully understand the NDT process, get feedback and self-reflection on performing NDT tasks, monitor the internal efficiency and improve the laboratory through a continuous evolution of NDT process.

Keywords: proficiency testing, continuous improvement, ISO 17043, ISO 9001, process control

1. Introduction
All NDT labs accredited according to ISO/IEC 17025 [1] need to pass annually a proficiency testing according to ISO 17043 [2], the so-called Inter-Laboratory Proficiency Testing (ILPT). The ILPT concept is to compare via an independent Proficiency Provider (PTP) a set of NDT labs against a template as well as against each other.

Proficiency testing acc. to ISO 17043 is, however, much more than only specific application for accredited NDT labs [3]. There is neither mandatory requirement nor restriction for the ordinary (non-accredited) labs. Successful participation in ILPT has proven to be successful tool for the selection of laboratories competent to perform NDT tasks. It delivers a systematic quality and improvement monitoring for subcontractors. And it serves as a tool to satisfy continues improvement requirements acc. to ISO 9001[4] without extra costs. Participation of ordinary NDT labs is therefore not only possible, but recommended.

There may be numerous reasons for participation. This article is going to introduce one specific application of the first option: how the proficiency testing can be helpful to non-accredited NDT labs, especially in terms of satisfying the requirement for continuous improvement acc. to ISO 9001.

2. Concept of Proficiency Testing
The concept of the Proficiency Testing is based on comparison of a set of NDT labs against a template approach (benchmark quality of NDT performance) as well as comparison each other.
The resulting competence verification is provided in the following levels:

- Pass/fail evaluation compared to a benchmark quality
- Performance (score or percentage) evaluation compared to the same benchmark quality
- Mutual comparison with competition (other participating labs)

It may be questionable how this can be so beneficial for a single, non-accredited NDT lab. There is no mandatory requirement for all ordinary labs in the given market sector to participate.

Therefore the comparison may be misleading for non-accredited labs, whereas for accredited labs, which should all participate annually, it is unambiguous. The next chapters explain why it is fully justified.

2.1 The Proficiency Testing process

At the beginning an NDT lab participating in a Proficiency Testing scheme (e.g. MT of welds) is assigned with a standard NDT task. This may be e.g. a carbon steel butt weld sample to be tested by MT yoke and suspension applied by a spray. All standard procedural requirements are provided (e.g. required conditions of testing and acceptance criteria).

The participating lab’s personnel are then asked to make this task in their own NDT lab, on their own equipment, in a specific time period. After the task is done, participating NDT lab sends the sample back to the Proficiency Testing Provider (e.g. ATG company) including the record of testing and evaluation of found defects (thus with a filled-in Test Report).

Proficiency Testing Provider (PTP) stores the results, checks the sample for cleanliness and defects due to transportation and handling in order to ensure equal conditions to all participants. Afterwards the provider sends cleaned sample to the next participating NDT lab in the same scheme. This is repeated until all the participants get this sample and test it in their lab.

In one scheme, always the same sample in a clean and undamaged condition is sent with a blank standard Test Report template to fill in. Due to obligation of the provider to ensure the same conditions of the sample, none of the participants is being privileged. The order of participants therefore doesn’t play any role.

After all participating NDT labs test the sample, the proficiency testing provider shall evaluate the results. The following objectives of NDT testing process are evaluated:

- Application of the NDT method
- Equipment utilization
- Detection of indications
- Evaluation of indications
- Record assessment
- Qualification of the personnel
- Meeting the deadline

Note: in accredited schemes Qualification of the personnel is omitted according to request of the Czech Accreditation Institute. Nevertheless, non-accredited schemes require it, because performing NDT tests by unsuitably qualified personnel is increasingly common, yet critical error in the process.

The result is provided as a document with overall score of all participants. Names in this document are being replaced by numbers for anonymity. Each participant is informed about the number assigned to him, but not about the numbers assigned to others. (Anonymity of
participants ensures that each participant gets the information about how he stands against the competition working in the same field, however he cannot use the information for unfair competition intents.)

The score breakdown is designed to provide information about competence in each of the objectives listed above. Each participant also gets a written evaluation of task’s assessment with errors done by his NDT lab. The purpose is to help the participant with designing corrective actions.

Each scheme by Proficiency Testing Provider ATG is limited to 1 year cycle [3]. In this period all participants test the sample, provide reports and are evaluated. In longer schemes the participating lab’s status may significantly change to both, better or worse. Therefore after several years the result may not be relevant.

2.2 Expected outcomes

By participating in the proficiency testing an NDT lab is able to assess information about his:

- Level of understanding of the NDT process
- Ability to do the testing process accordingly (by satisfying the benchmark criteria)
- Weak points of the testing process (by assessing the partial score results)
- Recommended adjustments of the testing to initiate improvement
- General information on where does the lab stand compared to the (international) competition, both in global aspect and in each of the objectives listed above

These results may be a powerful tool in continuous improvement of an NDT lab if utilized correctly. But if the organization just takes the result as granted, the added value is diminished.

3. Compliance with ISO 9001

Why an organization may want to participate in the proficiency testing? Why it is not enough to follow the procedures accordingly and be a diligent inspector? And why shouldn’t they just hire a consultant from the field of NDT to help them out?

These obvious and simple solutions have some important shortcomings that the next paragraphs try to explain. First of all, these simple solutions assume that the organization itself or a hired consulting body can do the job well at the first place. Second, it assumes that the organization being advised is able to assess the advice from the consulting body correctly and correctly put it in action.

A lot of organizations are struggling with understanding the NDT process as a whole. Not all of the parts are clear to them and therefore either they don’t do them at all, or perform it just only because it is required. Such organizations then tend to make repeated, costly errors.

3.1 Principle of ISO 9001

ISO 9001 is nowadays a standard benchmark of modern enterprise QMS. It teaches us that basically everything except most elemental activities is a process. A process acc. to ISO 9000 is a set of interrelated or interacting activities that transform inputs into outputs [4]. It means that to execute the process correctly, it must be initiated by at least one starting activity (input), be followed correctly (thus it means in correct interrelation and correct order) all the way through, and finalized in a given time, cost and quality (output).
Frequently, companies don’t understand the NDT process completely. It can be assumed that accredited Provider is competent to evaluate the assessment of NDT process correctly and is able to estimate whether the process drives to quality. First outcome of participation in Proficiency Testing is thus improvement in understanding of the NDT process by identification of all its parts and understanding their roles.

3.1.1 PDCA cycle

The core concept of ISO 9001 is a PDCA cycle (literally it is not directly enforced, but the whole concept of the ISO 9001 standard is all but this principle [5]). PDCA is a process principally running all the user-defined sub-processes, thus even NDT process. PDCA cycle stands for plan-do-check-act and in a very simple principle it tells the basic requirements to make a process handled well.

According to PDCA, everything should be first planned with defined goals and objectives, which usually are at least time, cost and quality (but may be more). Only after that the job shall be executed, which unfortunately some companies still take as the only important step they have to do. The final product is assessed and checked by various means of quality verification for being in conformance with the original plan. If an error emerges, it is expected that an adequate countermeasure is taken in order to eliminate it in the next run of this process.

This cycle is a closed loop that runs around for eternity. In a professional language this cycle (loop) is a concept called the continuous improvement process (CIP). It demonstrates that everything done repeatedly can be continually and never-endingly improved.

3.2 Continuous improvement process

Continuous improvement process is a process of never-ending improvement based on learning from experience [4]. It is based on three principles:

- **Feedback**: The core principle of CIP is the self-reflection of processes.
- **Efficiency**: The purpose of CIP is the identification, reduction, and elimination of suboptimal processes.
- **Evolution**: The emphasis of CIP is on incremental, continual steps rather than giant leaps.

The CIP utilizes the PDCA as the way how to assess these principles. By repeating the PDCA cycle it allows to the organization always move forward and establish that as a new internal standard of behavior in the given process. (Establishing improvement as a new company standard on regular basis is a management principle called consolidation through standardization.) Example illustration below.
3.2.1 Feedback

Once the process is understood in the principle at the first place, it can be consequently optimized by continuous reduction or elimination of suboptimal parts.

The Proficiency Testing (ILPT) allows the participants to see themselves compared to a template approach and get a self-reflection based on independent observer on whether they do their job well or not. If yes, everything is all right. If not, it is a signal that it’s time to do something with that before it will be too late.

3.2.2 Efficiency

If an issue is found, countermeasures should be developed in order to reduce its impact or even eliminate it for the future. Issues can enlist e.g. inappropriate personnel qualification, inadequate equipment, limited access to investment resources, misleading quality management system in the lab.

Countermeasure can be handled internally by the participating organization itself, or externally by a consulting body. The choice is on the participant, but the countermeasure must follow general requirements of their customers and standards and internal specifications applied in the lab.

The ILPT provider is obliged to identify and localize relevant information about what were the crucial errors. This helps the participant with designing countermeasures. Outputs of the proficiency testing can be therefore easily handed to anybody finding solution, even if it is outsourced to a consulting body.

3.2.3 Evolution

ISO 9001 recommends to assess improvement by evolution (continuous small improvements in order to fit to the system), not by revolution (extreme individual act of change) [5]. The reason for this approach is that with increasing extent of change the risk of negative impact is significantly increased. If small changes are done, even negative impact is small and can be easily assessed in the next round of the PDCA cycle. If big changes are done, there may be no more space to correct the negative impact anymore.

Incremental improvement model by evolution is one of the reasons why accredited NDT laboratories are required to participate annually. However, it is also the reason why independent, non-accredited labs are advised to participate on regular basis as well (not
necessarily annually) and continually monitor the ongoing competence and ongoing continuous improvement. It is not recommended to take the proficiency testing as a one-time ultimate countermeasure to all problems once for all.

3.3 Implementation

The implementation of the Proficiency Testing as a continuous improvement process is very simple. At the beginning the company participates in the first scheme for one or more NDT testing methods. The participation is not demanding and therefore doesn’t represent any burden for the organization. The result is used to set or adjust the standard quality of NDT services throughout the organization by interpolation to the remaining methods and industrial sectors (many things are solved similarly and many problems are a company-wide or lab-wide problem, not a problem of a particular method). At this point the main goal is to ensure complete understanding of the whole NDT process.

In the next step quality manual sets this situation as a new company quality standard and quantifies regular structure of its verification and continuous improvement. That should define at least:

- Repetition frequency
- Handling of particular methods
- Handling of particular industrial sectors

Such created model is not limited by any requirement of any standard, as long as we are not considering accredited NDT labs. Therefore the model may look e.g. as follows:

- **Participation with all methods per e.g. 2 years**
  This model is very similar to the model for accredited labs. It is complex and to some extent it may be more demanding considering the extent of countermeasures. On the other hand it can be utilized as a way how to prove to the customer that the quality of this organization’s service is adequate to those labs having accreditation.

- **Participation with at least one method per year**
  This method is more modest and less demanding, but still provides significant outcomes. It is because most of the potential issues found and the countermeasures proposed except the assessment of the particular method (first objective, see above) is a knowledge that is easily transferrable among methods and industrial sectors. This is suitable approach for continuous improvement program, but may find a reasonable application also in terms of demonstration of conformity.

The key point of the implementation of Proficiency Testing as the tool for continuous improvement is the regular participation, accompanied by self-reflection and application of effective corrective actions through evolution. Increasing the frequency above the annual basis of accredited labs shall not make the lab looking better than the accredited one. The reason is that the repetition frequency is not the driver of the quality, it provides only ongoing competence assessment. Therefore the basic requirement is diligence. It is necessary to execute what is planned, accept the issues found (do not downplay their significance), learn from the experience and implement with no delay countermeasures to improve the process. That should be done as soon as possible, not before the upcoming audit.

The worst that can be done in this matter is, nevertheless, to participate once and use the result as a marketing tool to justify high price of organization’s services. Despite powerful tool, it is no real proof of ongoing competence and it diminishes the efforts for making the process improved and therefore more effective and efficient.
4. Conclusion

Proficiency testing by ISO 17043:2010 is a new way how to verify competence of the NDT labs. It can be observed as internal management tool to monitor ongoing competence and quality improvement of participating organizations. When designed and executed well, it can be an undemanding, yet very effective continuous improvement tool for NDT process that can be implemented to organizations of any size.

In the meantime the Proficiency Testing is provided only by very few accredited providers. In the Czech Republic the accredited Proficiency Testing Provider is ATG, Ltd. [6]. This organization provides its services of inter-laboratory proficiency testing acc. to ISO 17043 worldwide.

The industrial world in the 21st century tends to higher quality. Means to achieve it may wary, but it is important to start soon, in order to not losing the edge against competition. Proficiency Testing acc. to ISO 17043 may be one of the effective tools for NDT labs that should be considered thoroughly by all organizations performing NDT tasks on regular basis.

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References